All of the classes of invertebrates found fossil are described in more or less detail according to the prominence of the classes. These are taken up first in a general way to acquaint the student with the hard parts and the relation of the soft parts to them. The orders and suborders adopted are up to date and these are next concisely described, but no further classification is offered, nor are the genera, even the common genera, defined. The various groups are illustrated by a few well-selected forms and these are carefully described in the legend as to the source whence obtained, the name of the animal, locality and formation, order or family and the symbols referring to the detailed structures.

Most of the classes are adequately treated for an elementary work, but a few are handled too briefly to give a proper conception of their intricacy. For instance, the crinoids are described in nine pages and the horde of Camerata in one, the Hydrophorida or Cystidea proper in four, the starfishes and ophiurids each in three, and the varied and very important Paleozoic trilobites in six. American paleontologists will be also disappointed to see the Trepostomata Bryozoa still ranged among the tabulate corals.

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Light. By Richard C. Maclaurin, President of the Massachusetts Institute of Technology. New York, published by the Columbia University Press. 1909.

A popular exposition of selected topics, being the Jesup lectures delivered at the American Museum of Natural History during the winter of 1908–9. This book, while not comprehensive enough to serve as a text-book, will meet the requirements of those who wish to acquaint themselves with the experimental part of the work that has given us our modern theory of light. The subjects are treated in the following order: (1) Early Contributions to Optical Theory, (2) Color Vision and Color Photography, (3) Dispersion and Absorption, (4) Spectroscopy, (5) Polarization, (6) The Laws of Reflection and Refraction, (7) The Principle of Interference, (8) Crystals, (9) Diffraction, (10) Light and Electricity. The author's standing as a physicist is a sufficient guarantee that the book is free from errors, and the subject is treated in a very readable manner, free from mathematics and requiring little or no previous knowledge of the subject on the part of the reader. It brings the subject down to date, or as much so as can be expected in a popular treatment.

R. W. Wood

RECENT VIEWS OF L. CUENOT ON THE ORIGIN OF SPECIES BY MUTATION[1]

The results obtained in the study of variation from the point of view of its origin, of its morphological significance and of the integral transmission of mutations as opposed to fluctuations, could not but exert a profound influence on the hypotheses that have been brought forward to explain evolution. It is of particular interest to compare these results with the classic theories of Lamarck and Darwin. Primarily, these are attempts to account for the phenomena of adaptation: Lamarck invokes use and disuse, effort and habit, and considers their effects as directly adaptive and hereditary; thus he explains the evolution of organs necessary for life in certain surroundings and the regression of those that are useless under an animal's particular environmental conditions.

Darwin, while admitting the effects of use and disuse, emphasizes above all the selection of minute fluctuating variations, favorable in the struggle for existence, and thus he explains morphological changes and the final perfection of adaptation in an organ as the result of a slow and continuous progress.

To be sure, the sudden appearance of certain mutations, transmissible in their entirety, and the instability of fluctuating variations, are factors not at all in accord with Lamarck's attempted explanation, nor with that of Darwin; but perhaps there are no longer many

[1] Cuénot, L., 1908, "Les Idées Nouvelles sur l'Origine des Espèces par Mutation." Translated from *Rev. gén. Sci. pures et appliq.*, Ann. 19, no. 21, 15 nov., 1908.

rigorously orthodox Lamarckians or Darwinians among biologists. Little by little, just as modern houses are built with the ruins of ancient temples, an edifice has risen out of the crumbling theories of Lamarck and Cope, of Darwin and Wallace, of Eimer and Weismann —an interpretation of evolution which retains the tested facts of all previous attempts at a general explanation and which, with no pretense of finality, keeps the unbridged gaps well in view. Seven years ago, I wrote for the *Revue* an article[2] in which this theory was anonymously set forth and I find it needs very little modification at the present time. According to this theory, the unforeseen modifications of the germ plasm—whether called mutations or sudden or discontinuous variations—produced at a last analysis by environmental changes, are the source of the morphological and physiological differences that distinguish one definite species from another. This, as will be readily seen, is neither Lamarckism nor Darwinism. Natural selection controls development in animals and in plants by the elimination of the individuals and species not adapted to survive under given conditions, a selection which permits only the "fit" to exist. The adaptations indispensable for life in given surroundings must therefore precede chronologically these environmental conditions and they are not determined by the conditions to which they seem to correspond with such nicety. Herein lies the most original point of the theory and one that will, no doubt, meet with the greatest opposition. I prefer not to dwell upon it here but shall defer its demonstration to a later time.

THE FILLING OF UNOCCUPIED PLACES IN NATURE AND THE ORIGIN OF ADAPTATIONS[3]

IN the theory of the *survival of adaptive mutations,* as set forth above, neither Lamarckian factors nor the selection of minute variations determines the appearance of new characters. The mutations occur fortuitously as continuous or discontinuous, the result of modifications in the germ plasm. If by chance the variant, such as it is or by some change of function, is adapted to fill a void in nature and is able to reach this unoccupied place, it has the opportunity to survive and to found a new stock; if not, it remains in its original surroundings or disappears. Formerly, when unoccupied places were more abundant, in fresh water, in marshes, in cracks and caverns and on the earth's surface, in the air, in the polar regions, conditions were favorable to the differentiation of new species and new groups; now mutations have an ever-decreasing chance of finding an occupied place in the fine balance of life already established, and evolution, if not entirely checked, has at least become much retarded.

[2] L. Cuénot, "L'évolution des théories transformistes," *Revue générale des Sciences,* t. XII., p. 264, 30 mars, 1901.

[3] Cuénot, L., 1909, "Le Peuplement des Places Vides dans la Nature et l'Origine des Adaptations." Translated from *Rev. gén. Sci. pures et appliq.,* Ann. 20, no. 1, 15 janvier, 1909.

SPECIAL ARTICLES

THE QUESTION OF VIVIPARITY IN FUNDULUS MAJALIS

IN a paper dealing with the process of heredity in *Fundulus* hybrids[1] certain well-marked differences were shown by the writer to exist between the two reciprocal crosses. While a large per cent. of the hybrids, obtained by fertilizing the eggs of *Fundulus heteroclitus* with the sperm of *F. majalis,* hatched and, in some cases, throve for months after hatching, the embryos of the reciprocal cross (*F. majalis* eggs fertilized with *F. heteroclitus* sperm) developed well for about two weeks and then ceased to grow. These embryos developed from the larger eggs of the larger species, yet reached a maximum size only equal, on the average, to that of the just hatched young fish of the smaller species, *F. heteroclitus.* Although morphologically sufficiently advanced, they never hatch, but remain stranded on a large yolk mass which they seem incapable of assimilating.

These and other peculiarities of cross-bred

[1] "The Process of Heredity as Exhibited in the Development of Fundulus Hybrids," *Journal of Experimental Zoology,* Vol. V., No. 4.